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# The state diagrams of benzene-methanol mixtures

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CITATION:

Kinoshita, Hideo ...[et al]. The state diagrams of benzene-methanol mixtures. The Review of Physical Chemistry of Japan 1953, 23(1): 35-37

ISSUE DATE:

1953-09-05

URL:

<http://hdl.handle.net/2433/46692>

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# THE STATE DIAGRAMS OF BENZENE-METHANOL MIXTURES

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## Introduction

The P-V-T relations of one component system, either benzene or methanol, have already been reported, and not in reference to the P-V-T relations of benzene-methanol mixtures. Therefore, the authors studied these relations by the constant volume method.

## Apparatus

The apparatus used is the same as in the case of the previous paper<sup>1)</sup>. The autoclave is made of stainless steel and its capacity is about 29 cc. The temperature is measured by means of the thermocouple inserted in the wall of autoclave.

## Samples

Both benzene and methanol were purified by successive fractional distillation, and for benzene the distillate of the boiling point  $79.2 \sim 79.4^\circ\text{C}$ , and for methanol that of the boiling point  $64.5 \sim 65.0^\circ\text{C}$  were used respectively. The mole ratios of the mixtures were  $\text{C}_6\text{H}_6 : \text{CH}_3\text{OH} = 2:1, 1:1$  and  $1:2$ . As to the density of the mixture at each temperature  $d_t^i$  the value obtained from the straight line passing through the two points of  $d_t^{12.57\ 2)}$  and  $d_t^{25\ 3)}$  was

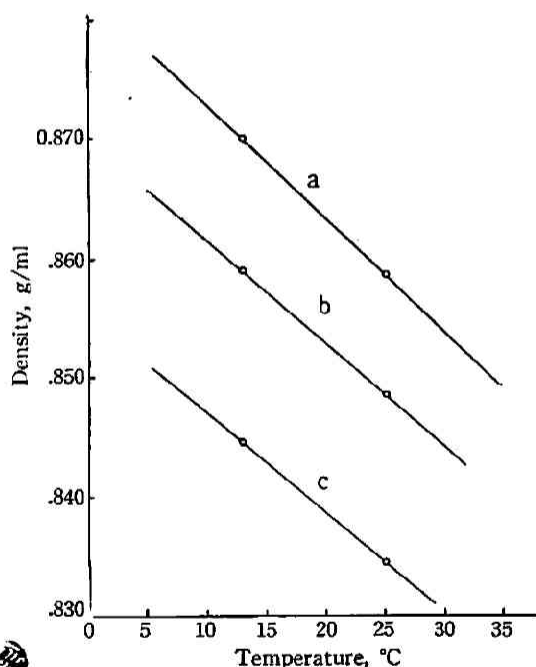


Fig. 1 Density of  $\text{C}_6\text{H}_6\text{-CH}_3\text{OH}$  system  
 $\text{C}_6\text{H}_6 : \text{CH}_3\text{OH}$  (mole ratio)

a 2 : 1  
b 1 : 1  
c 1 : 2

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1) R. Kiyama and H. Kinoshita, *This Journal*, 21, 9 (1951)

2) International Critical Tables, Vol. III, 151 (1928)  $d_t^{12.57}$  at  $\text{C}_6\text{H}_6 : \text{CH}_3\text{OH} = 1:2$  is extrapolated from  $\text{C}_6\text{H}_6 : \text{CH}_3\text{OH} = 1:0 \sim 1:1.515$ .

3) C. C. Williams, S. Rosenberg and H. B. Rothenberg, *Ind. Eng. Chem.*, 40, 1273 (1948)

used. This is shown in Fig. 1. The difference of the packed volume of the mixtures by temperature change is small as the difference of the density is small. The difference of the packed volume of the mixtures at specific volume 1.4 ml/g or 15 ml/g between 12.87°C and 25°C is about 0.4 cc or 0.04 cc.

### Experimental Method

As to the way of packing the sample and the experimental methods, they are all the same as in the case of the previous paper<sup>1)</sup>, except keeping the system at constant equilibrium temperature and pressure in order to be observed for one hour.

### Experimental Results

The experiments were performed under the following conditions—mole ratios between benzene and methanol were 2:1, 1:1, 1:2, temperatures 150, 200, 250, 300°C and specific volumes 1.4 ~ 15 ml/g. The results are shown in Table 1 and Figs. 2, 3 and 4.

Below 300°C, while the system was kept at a constant temperature, the increase of pressure could not be observed and after cooling the residual pressure not be observed

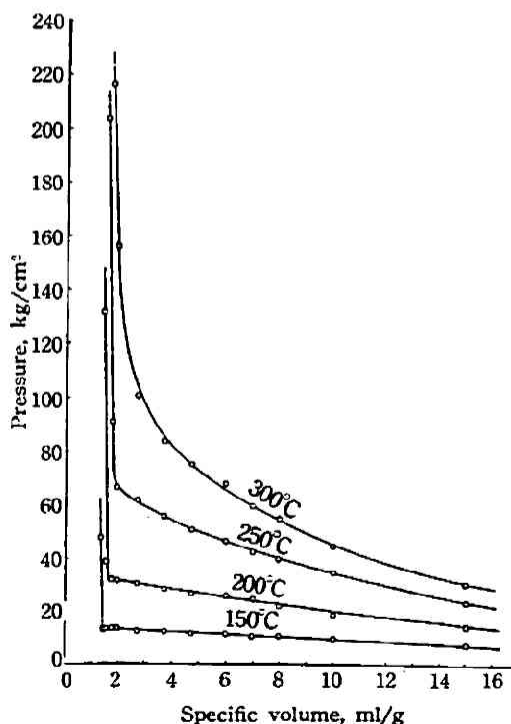


Fig. 2 Isotherms of  $C_6H_6$ - $CH_3OH$  system  
 $C_6H_6:CH_3OH=2:1$

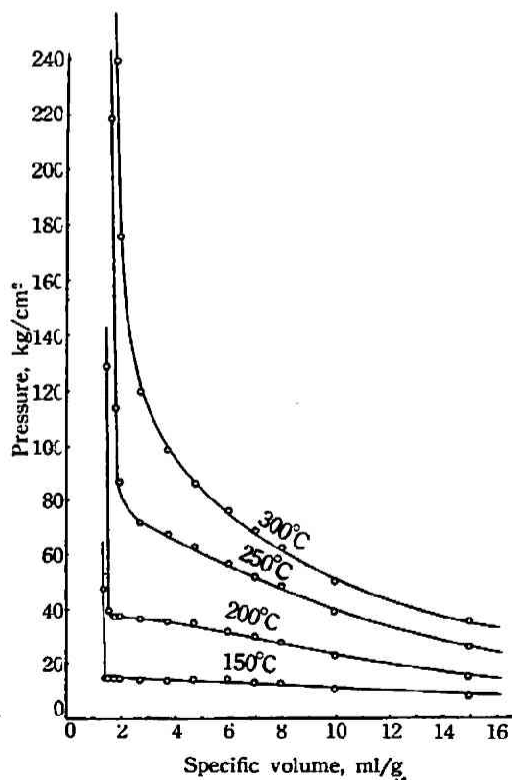


Fig. 3 Isotherms of  $C_6H_6$ - $CH_3OH$  system  
 $C_6H_6:CH_3OH=1:1$

## The State Diagrams of Benzene-Methanol Mixtures

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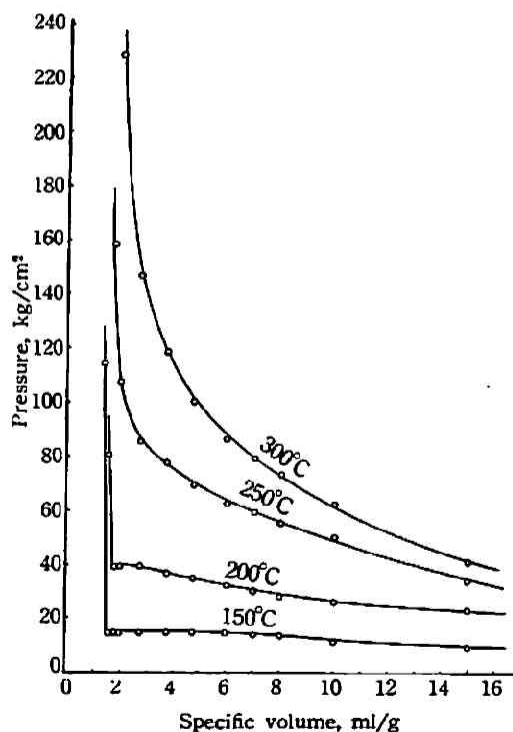
Table 1

sp.	Pressure (kg/cm <sup>2</sup> )											
	150°C			200°C			250°C			300°C		
	2:1	1:1	1:2	2:1	1:1	1:2	2:1	1:1	1:2	2:1	1:1	1:2
15	7	8	9	14	15	23	23	26	34	30	36	41
10	9	10	11	18	22	26	34	39	50	44	50	62
8	10	12	13	21	27	28	39	48	55	54	62	73
7	10	12	13	24	29	30	42	51	59	59	68	79
6	11	13	14	25	31	32	46	56	62	67	75	86
4.75	11	13	14	26	34	35	50	62	69	74	85	100
3.75	12	13	14	28	35	37	55	67	77	83	98	118
2.75	12	13	14	30	36	39	61	71	85	100	119	146
2	13	14	14	31	37	39	66	86	107	155	175	228
1.8	13	14	14	31	37	39	90	113	158	216	239	
1.6	13	14	14	38	39	80	203	218				
1.5	13	14		131	128							
1.4	47	47	114									

t : Temperature

m : Mole ratio between benzene and methanol

sp. : Specific volume, ml/g

Fig. 4 Isotherms of  $C_6H_6-CH_3OH$  system  
 $C_6H_6:CH_3OH=1:2$ 

either, so that it is considered that the decomposition of the sample did not occur at length (about 10 hours).

The authors express their hearty thanks to Prof. R. Kiyama for his encouragement and revision. The authors are indebted to the Department of Education for the Grant to the Cooperative Research (The Fundamental Research on High Pressure Industries directed by Prof. R. Kiyama).

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